SCIENCE

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THE CHEMISTRY OF SOILS.[1]

BY PROFESSOR R. ELLSWORTH CALL.

A SOMEWHAT extended experience in the chemical analysis of soils with a view to their agricultural value has led to certain conclusions which may not be altogether devoid of value to the readers of *Science*. Especially may this be true since there is often an entirely erroneous opinion among those most concerned respecting the useful deductions which may be made from a complete chemical analysis of a soil. Usually it happens that if only the presence of certain desirable substances be shown, then the value of the soil for the production of this or that crop is assumed to be definitely settled. Nothing could, in general, be farther from the truth. Of course, something definite may be said of such soils as those in which both sand and clays, or either, predominate, but the conclusions in these cases are based on the physical characteristics of the soils rather than on their chemistry. Indeed, it is usual to classify soils in two general categories, the classification being based, on the one hand, on the method of soil-formation, and, on the other hand, on its physical characteristics. The soils of Iowa belong, in the main, to that class which is based on the method of formation, and are composed chiefly of transported or drift materials. It is, however, true that the Iowa soils, though glacial, owe much to the physical characters of the rocks which they represent as disintegrated and far-travelled *débris*. The sands and clays are all transported materials, most of them from points many miles to the north of the prairie regions which they now cover. It is, moreover, clear that no degree of coarseness or of fineness, which may result from the methods of origination of any soil, constitutes in itself sufficient ground for saying this soil is fertile or that soil is unsuitable for plant growth. Recourse must be had to the ultimate composition of the sample, and right here enters an element of error against which, popularly, it is difficult to guard.

The physical character of a soil or marl must be considered when studied chemically. The finer the condition of the sample, in nature, the more readily are induced those changes in its chemistry which result from atmospheric influences. That is to say, when coarse and fine soils are treated alike mechanically by the plow, the one may become mellow and well mixed, while the other is broken without being well mixed or turned. Now, the chemical processes which occur are most active and most complete in soils that are fine in texture. It follows, therefore, that a stiff, clayey soil may contain all the essential elements of the food of any plant, but be in such condition physically as to render the chemical processes difficult of operation. And, on the other hand, such a soil may be sufficiently fine, but the well-known tendency to "cake" or harden on drying or exposure would render it valueless agriculturally, no matter how finely comminuted its materials may be.

[1] Extracted from the Monthly Review Iowa Weather and Crop Service, Vol. III., No. 5, May, 1892.

Clayey soils, again, do not permit that free, subsoil circulation of water so necessary to growing crops. Circulation there is, but it is limited at best; open, porous soils admit free, underground water-flows, but such soils soon dry. They lose large quantities of water through evaporation, due to the rather free circulation of air in the upper portions of the cultivated areas.

Color, too, has little to do with deciding finally whether a soil will be fertile. Usually all earths which are dark-colored or black—a condition largely due to the amount of carbonaceous material derived from decayed vegetation — are considered fertile. It is true that common consent places all such samples among the fertile soils, but it by no means follows as a necessary deduction. So, too, that light drab or ashy-colored soils lack the elements of fertility is a notion which observation and experiment alike negative. The most fertile of Iowa soils is the loess, a peculiar and very fine marl covering many hundred square miles along the Mississippi and Missouri rivers, as well as the higher lands along the Des Moines. It is a soil the color of which would condemn it for agricultural purposes, but it is one which is of exceptional value for all sorts of cereals, and is peculiarly adapted to the growth of fruit. It is finer in texture than is any other soil in the State. What, then, constitutes its peculiar feature, rendering it so valuable? The answer to the query lies almost solely in its physical condition, which is of a fineness equalling that of any clay. This fine condition renders it admirably suited to the action of native chemical agents. These are the real soil-makers. Soils that plants may use must be soluble, and one of the essentials to complete solubility is fineness of the constituent particles. A certain and definite relation to moisture must be established and maintained, a condition which is practically reached by under-draining soils of a clayey nature. Too much water will compel adhesion of the smaller particles, and the product thus formed be eventually coarse and lumpy. Such a soil may be very fertile, but is not arable. This is the condition of most of the bottom lands of eastern Arkansas, the soils of which region are deficient in lime alone of all the ingredients which plants require. They are "wet and cold," and cannot be under-drained. Few soils of this nature occur in Iowa.

To make a long story short, chemical analysis of any given soil will determine its probable agricultural value only within very wide limits, and for reasons which appear below. It may be said, at this time, that such an analysis may determine one of two things, (*a*) the presence or absence of constituents which the plant must have, or (*b*) the presence of some substance which will affect injuriously a growing plant. The chemical laboratory will never supplant the province of carefully conducted experimental agriculture. But it may become a most valuable adjunct to the operations of the farm. The principles which underlie agricultural chemistry need only to be understood to be appreciated by those who have the manual labor of the farm to perform.

Aside from these general considerations there remain yet others to which it will be well to advert.

One of the great difficulties in the way of an intimate knowledge of the relations of plants to soils lies in our ignorance of the laws of assimilation in the plant. The conditions under which the chemist studies these are of necessity artificial. He cannot be assured that he has even measurably reproduced the conditions of nature, and hence cannot be sure that similar results will be attained under such most natural conditions. Those most complex and peculiar changes which occur in chemical compounds under what, for want of a better term, are denominated "vital forces" can never, at least under the present limitations of knowledge, be fully understood. And right here is the gist of the whole matter. A knowledge of the chemical constitution of a soil must precede a study of its relations to the full or incomplete, as the case may be, development of a plant dependent on it for nourishment. In other words, the constitution of a soil is a determinable quantity, the life-processes of the plant constitute an indeterminate quantity, and the relation of the two is the thing sought. No amount of chemical experimentation can bring into view the unknown factor.

The various experiment stations which are now established in every State in the Union can do much toward clearing away a great cloud of agricultural superstition relative to these subjects. There should be place for the theoretical as well as the practical in their work. It should be clearly shown that the constitution of a soil has far more to do with the growth of a crop of corn than the moon, or than any other of the oft-quoted and still entertained notions of strange and hidden forces. Tall oaks do not grow from little acorns except under the most favorable conditions of soil, and these conditions, again, are affected by the innumerable changes which occur in temperature, moisture or other variables, which render more or less tractable the various compounds on which the plant must feed.

The chemist who studies a soil does so by the same methods as those by which he would examine an unknown mineral, and usually with no greater care. He wishes, simply, to know what elements may occur in it, under what conditions, in what abundance, to what degree they may be dissociated, and whether there be present any substance which would interfere with their assimilation by the plant. In this way he arrives at a fair knowledge of the sample, but he can tell you little of its value for agricultural purposes. He here depends not on his knowledge of soil constitution or of its genesis, but on the facts of observation, which are familiar to every farmer, and which he unconsciously connects as cause and effect. It does not need a chemist to tell an observant farmer that he will not be likely to reap a strong growth of wheat from a sandbar. He has had as an instructor an experience in the relations of crops to the labor expended on them that led him to definite and valuable conclusions on this matter. But there are innumerable questions which he may put to the chemist and hope for a profitable answer. When once the soil has been exhausted of a necessary constituent he may learn from experience that this or that material judiciously applied will remedy the defect. The farmer, moreover, has yet to learn that, even in Iowa, there cannot be a constant draft on a soil and the same crop be produced with equal value each year for an indeterminate number of years. Each crop lessens the productive power of a soil by the amount of material which it removes from the soil each season. Here it is possible for the chemist to aid the producer by telling him exactly what has been taken from the soil, and thus indirectly telling him what is needed in the compost he may apply. This borders on organic chemistry and does not at present concern us.

Among the substances which must be present in a soil to give it an average degree of fertility stands pre-eminent the compound known as phosphoric acid. But this substance does not exist in the soil except in combination with some other substances, known technically as bases. These substances are commonly, if not always, iron and alumina, with which they are in such chemical combination as to form salts known as phosphates. It is, however, not sufficient to know that these compounds are present. We must further know whether they are so associated with other compounds as to be readily disintegrated and rendered soluble, for unless soluble they cannot be used as plant-food. Now, neither of these compounds of phosphoric acid — *i.e.*, iron and alumina phosphates — is available in that form. Experiment has shown that the form in which these substances are available is that of calcium (lime) phosphate. That this has a relation to the amount of calcium silicate in the soil is clearly proven, and that by a process of double decomposition of the three compounds the available one is obtained is also well known. But this process has not yet been certainly traced in nature. As stated at the beginning, it is right here that the processes of the laboratory and those of nature need to be connected. Whether they ever will be depends upon the support given to the great army of practical chemists whose attention is now directed to the theoretical features of agricultural chemistry.

It should be a matter of congratulation to the farmers of Iowa that work along these lines is now progressing very favorably at the experiment station at Ames. A vast amount of valuable information may be expected from this source, and in due course of time it will come.

CURRENT NOTES ON ANTHROPOLOGY. — X.

[*Edited by D. G. Brinton, M.D., LL.D.*]

The Ancient Libyan Alphabet.

In *Science*, May 8, I called attention to the new light thrown upon the history of our alphabet in its ancient form by the researches of Dr. Glaser among the ruined cities of Arabia. Another curious study in the same line is that offered by the Libyan alphabet. It appears to have been in common use among the Berber tribes of North Africa long before the foundation of Carthage, and is still employed constantly by the wild Touaregs of the Sahara. It is not the same as the Iberic alphabet of Spain, and in its forms is almost entirely independent of the Phœnician letters. It is composed of consonants, called *tifinar,* and vowel-points, known as *tiddebakin*. The latter are simple dots, the former are the lines of a rectangle, more or less complete. Several of them are found in the oldest Etruscan inscriptions, and on that known as the "inscription of Lemnos." Sepulchral epitaphs in this alphabet have been discovered dating two or perhaps three centuries before the Christian era; while rock-inscriptions of perhaps more ancient date, showing extremely archaic forms of the letters, have been copied from localities in the southern Atlas ranges.

The writers who have given especial attention to this little-known subject are Faidherbe, Duveyrier, Halevy, Bissuel, and, recently, Dr. Collignon, who has a brief summary of results in a late issue of *Les Sciences Biologiques.*

The Aborigines of Asia Minor.

The artistic and linguistic studies into the proto-ethnology of Asia Minor (see *Science*, May 20) are happily supplemented

by the investigations of Dr. F. von Luschan of Berlin, on the Tachtadschy of Lycia, published in the *Archiv für Anthropologie.* This *nomen gentile* is not ethnic, but means merely "wood-choppers," or "board-makers." It is applied to a shy, secluded people, who live in the mountains, and fell and dress trees as their main business.

On measuring them, Dr. von Luschan found that they had unusually short and high skulls,— hypsi-brachycephalic, —and were of small stature, with dark hair and eyes. Comparison with some skulls from very old Lycian graves, and with part of the present population of Armenia and other portions of the region, led him to the conviction that in this type — so markedly distinct from that of the Greeks and Semites — he had before him the original of the most ancient population of the land. He considers it certain that it extended over the whole southern half of Asia Minor; northeast to the Caucasus; east to the upper Euphrates; but its northern and western limits are not yet defined. He even hints that the short, dark, brachycephalic people of central Europe may be the western extension of the type.

As to whence it came, he is not without an opinion. Not from Europe, not from Africa, not from northern Asia, not from southern Asia; all are excluded for sufficient reasons; central Asia alone is left; and somewhere in that mysterious *matrix gentium* he expects will be found the ancestral connections of this well-marked type. There, then, we should search for the linguistic analogies of the Cappadocian words quoted from Professor Tomaschek in my previous article. It would be a brilliant corroboration of a purely physical study in anthropology to discover such analogy.

Work of the Eleventh Census Among the Indians.

It is not generally known — in fact, it is pretty hard to find out — how much excellent anthropologic material is annually collected and in part published by the various departments of our central government. The army, the navy, the surgeon-general's bureau, the Smithsonian, the National Museum, and the specially created Bureau of Ethnology, all pour forth every year quantities of valuable observations.

Nor has the Eleventh Census been behind in this good work, as is testified by the "Extra Census Bulletin," just out, on the Six Nations of New York. It is but the forerunner of a series of such Bulletins on the remnants of our aboriginal population, and is an excellent earnest of the merits of its successors.

The aim of these bulletins is to supply first-hand and accurate statements of the present social, religious, industrial, vital, and political condition of the tribes; in other words, they are ethnographic, in the right sense of the term. The general editor is Mr. Thomas Donaldson, and in this instance his collaborator is General Henry B. Carrington. A large quarto of 89 pages, well indexed, with maps and photographs, gives a most satisfactory account of the present status of the Cayugas, Mohawks, Oneidas, Onondagas, Senecas, and Tuscaroras. The action of the Census Bureau in this direction is the more welcome, as in the rapidly changing condition of the native tribes, not many censuses will have the material with which to occupy themselves in this direction.

The Extension and Study of the Nahuatl Language

If we may judge of the superiority of a language by its vitality, and by the impress it leaves on others with which it comes in contact, we must assign a high place to the Mexican or Nahuatl. It is still spoken in comparative purity by considerably over a million people, and it has made a deep impression on the Spanish of most of the Mexican and Central American States.

For Costa Rica, this has been shown in a work issued in the present year at San José de Costa Rica, by Señor Juan Fernandez Ferraz, formerly inspector-general of education in that republic. It is entitled, "Nahuatlismos de Costa Rica," and is a neat octavo of about 150 pages, with an introduction on Nahuatl grammar of 75 pages. The alphabetical list shows that a large number of terms in the current speech of Costa Rica, which have assumed the form of Spanish words, are derived from the Mexican tongue.

A similar work for Nicaragua, written by the late Dr. C. H. Berendt, is now preparing for the press under the efficient editorship of Dr. K. Lentzner of Berlin. The Nahuas, or a colony of them, once occupied a considerable tract on Lake Nicaragua, and left the marks of their occupancy not only in interesting ruins, but on the language of their conquerors as well. It was in this Nahuatl-Spanish dialect that the comedy of Gueguence was written (published in Philadelphia, in 1883).

It is agreeable to note in this connection that the study of the Nahuatl finds zealous advocates in Mexico, among whom the names of Peñafiel, Palma, Hunt y Cortes, Altamirano, Caballero, and Rosa, hold conspicuous places.

Anthropology at the Columbian Exposition.

Anthropology does not appear by name at the Chicago "World's Columbian Exposition." This is to be regretted, as it is a fine opportunity lost to inform the people of the United States what this grand science is, and how its several branches stand related to each other.

It is represented, in fact, in "Department M," with a most competent chief, Professor F. W. Putnam of Cambridge. A descriptive pamphlet of this department which has just been issued announces that it includes "Ethnology, Archæology, History, Cartography, Latin-American Bureau, Collective and Isolated Exhibits,"— rather a miscellaneous stock. It is further stated that there will be a section on physical anthropology and an anthropological laboratory, which are classified as a subdivision under the section of ethnology. In spite of these defects in classification, no doubt abundant and excellent material will be provided for the student, which he can work up in his own way. A correspondent in Berlin informs me that Dr. U. Jahn, who has charge of the matter there, has prepared, among other things, a series of specimens of German houses of all varieties, to be erected at Chicago, and in one of them, the *rathhaus*, he will arrange a complete exhibition of ancient and modern German costumes, domestic utensils, home manufactures, etc. The sections at Chicago on Folk-Lore, Games, and Primitive Religions will be under the supervision of Stewart Culin Esq., of Philadelphia, who has lately been appointed General Director of the Museum of Archæology attached to the University of Pennsylvania.

NOTES AND NEWS.

VERY numerous experiments have been recorded to show that moisture is saved by cultivation. Frank E. Emery of the North Carolina Experiment Station says: "During this hot, dry weather every foot of plowed land should be kept well stirred on the surface with any tool which tends to keep it from baking. A loose, fine surface will hold down water like a wet blanket. A field kept thus may give an increase in crop over one not cultivated equal to that produced by a heavy application of fertilizers. Preservation of the soil-water thus becomes of great importance. A

blanket of fine soil on the surface during a hot, dry week can be of great value to the crop and really become the turning-point for profit if present when loss might result from its absence."

— The North Carolina Experiment Station has just published a 26-page Bulletin (No. 84) dealing with the fungous and insect enemies of garden and truck crops. The trucking interest has become one of the most important in the State. Good home gardens are not, however, so plentiful as they would be were it not for the ravages of insects and diseases. This Bulletin gives ten different formulas for compounding insecticides and fungicides, and explains the necessity for garden hygiene. The most approved forms of spraying apparatus are illustrated and described, and some trustworthy dealers in fungicidal chemicals are named. Everyone who has even a small garden is interested in the matters this Bulletin treats of. It is sent free to all residents of North Carolina, and will be sent as long as the supply lasts to residents of other States who send 6 cents in postage stamps. Address N. C. Experiment Station, Raleigh, N.C.

— Dr. Arthur MacDonald, specialist in education as related to criminal and abnormal classes, United States Bureau of Education, Washington, D.C., has been appointed official representative of the United States to attend the international congress for experimental psychology at London and also the international congress upon criminology at Brussels. The congress at Brussels will consider crime in its relation to biology and sociology. The congress is extremely cosmopolitan not only as to nationalities, but in the different departments of knowledge which it includes. The criminal must be studied as a member of the race, and this gives rise to the new science of criminal anthropology, or, in short, criminology. Here such questions will be discussed as to whether there is a criminal type distinguished by shape of cranium and face, anatomy of ears and nose, size of orbits and length of jaws. Another important question under this head is whether the criminal is born so or becomes so from his surroundings. In this division of the programme are the names of the celebrated Cesare Lombroso, professor of legal medicine at Turin, and Dr. Brovardel, president of the medical faculty at Paris, and Professor Ferri, senator at Rome. But the criminal must be studied psychologically, that is, as to the nature of his mind and will, and their relation to insanity and moral insanity. Among those who will speak in the congress on this phase of criminality are Dr. Magnan, chief physician of the Saint Ann Insane Asylum of Paris; Dr. Benedikt, the celebrated craniologist at the University of Vienna; and the brilliant French writer and legalist, Judge Tarde. Another and very important side of the criminal is included under the head of Criminal Sociology. This takes up crime in history and politics, the influence of profession and trade on criminality and their bearing in the determination of penalty. But there is a practical as well as a scientific point of view in the study of the criminal. This will be considered in the congress under the title of "Legal and Administrative Applications of Criminal Anthropology." Thus Dr Alimena of Naples will discuss what measures are applicable to incorrigible criminals. Then there are the general and fundamental principles of the school of criminal anthropology, which will be considered by Dimtri Drill of Moscow. Dr. Manouvrier, professor in the School of Anthropology at Paris, is to read a paper on the "Innateness and Heredity of Crime;" Dr. Bruxelles on "The Functional Causes of Crime;" Dr. Sernal on "Suicide and Insanity in Criminals." The distinguished Lacassagne, professor at the University of Lyons, will speak on "The Primordial Sentiments in Criminals." and Dr. Fioretti of Naples on "The Applications of Anthropology to Civil Law." Thus it will be seen that not only specialists in criminology, but those in medicine, insanity, law, psychology, anthropology, and sociology, all will consider the criminal from their respective points of view. The congress for experimental psychology represents the precedent tendency of applying scientific methods to study the relation between mind and body, or mind and brain, subjects which are of as much interest and importance in the case of criminals as of normal men. This is illustrated by the new psycho-physical instrument called the plethysmograph, which indicates the least increase of blood in the arteries of the arm. Thus it has been found, that when the sentence of the judge is read before the criminal, there is a decrease in the flow of blood in the arm, but the sight of a glass of wine increases the flow; when, for example, it is required to multiply nine times seventy-three an increase in blood-flow is the result. The flow is little affected in a brutal murderer or born criminal, when a pistol is shown to him, whereas in the normal man the plethysmograph indicates a decided effect. The importance of this new instrument lies in this, that involuntary testimony is given as to the nervous and physical nature of the criminal. It is often unknown to him, and in spite of himself. Dr. MacDonald, after attending these congresses, will visit and study a few of the principal prisons and charitable institutions in England, France, Germany, Belgium, Switzerland, Austria, and Italy. A work of Dr. Macdonald's, entitled "Criminology," will soon be published by Funk & Wagnalls of New York. It is dedicated to Professor Lombroso, who writes the introduction and who himself is the founder of the new science.

— A society which may have opportunities of doing much valuable work has been formed in Wellington, New Zealand, as we learn from *Nature*. It is called the Polynesian Society, "Polynesia" being intended to include Australia, New Zealand, Melanesia, Micronesia, and Malaysia, as well as Polynesia proper. The president is Mr. H. G. Seth-Smith, chief judge of the native land court, while the Queen of Hawaii is patron. There has just appeared the first number of the society's *Journal*, in which there are papers on the races of the Philippines, by Elsdon Best; Maori deities, by W. L. Gudgeon; the Tahitian "Hymn of Creation," by S. P. Smith; Futuna, or Horne Island, and its people, by S. P. Smith; Polynesian causatives, by E T.; and the Polynesian bow, by E. Tregear. There is also a paper giving the genealogy of one of the chieftainesses of Rarotonga, by a native of Rarotonga. The original was written in 1857, and is printed in the *Journal*, with a translation by Mr. Henry Nicholas, and notes by the editors. The editors are of opinion that the paper "apparently supports by direct traditional testimony the theory propounded by Hale, and subsequently advocated by Fornander, of the occupation of the Fiji Group by the Polynesian race, and of their later migration eastward to Samoa and the Society Group."

— The second annual meeting of The Mechanical Engineering Teachers' Association will be held at Rochester, N.Y., beginning Aug. 18, 1892. This place and time of meeting is chosen as coincident with that of the American Association for the Advancement of Science in order to accommodate those who will wish to attend both meetings, and who may not be able to do so if at different times and places. The object of this association perhaps is best stated in Art. II. of its Rules, viz.: "To determine upon, and to secure by co-operation, the best courses of study, and the general adoption of methods of instruction, leading to the highest efficiency of schools of mechanical engineering." The meeting last year was largely occupied with the organization of the association, so that comparatively little time could be devoted to the consideration of courses, methods, or appliances, either by reading of papers or discussion. But it is hoped that the Rochester meeting of this year will be productive of great good in crystallizing the views of the now quite large body of professors and teachers into such tangible and acceptable matters of opinion as to form a working basis for all. The following points are suggested as of importance for study by way of preparation for good work at the meeting, either in the presentation of papers, topical or general discussion, viz.: What subjects should be embraced in the course of mechanical engineering leading to graduation? Should any of them be optional? Should there be a post-graduate course, and if so in what should it consist? What should be the degrees for the above, and what the studies? Should there be included one or two modern foreign languages? What engineering studies should be included? What amount of mechanical laboratory should there be included? What subjects should be included in the mechanical laboratory? How much practice with the object of mechanical and manual training? How much fine mechanical practice such as scraping of surface plates, grinding of standards, etc.? Should the construction of articles of manufacture be attempted at the school laboratory? What testing should be at-

tempted? Should any part of the laboratory practice be classified as shop work, and so named, unless articles are made for sale? Should anything be introduced that should be called "shop work?" Should that portion of the laboratory embracing the manual element be classified as "shop," "school shop," "work shop," etc., or elementary mechanical laboratory? Should the more advanced portion embracing testing of various kinds be classified in such way as advanced mechanical laboratory, testing laboratory, etc.? It is further suggested that particular attention be given to the number of hours devoted to a subject, and the ground covered; the method of instruction, i.e., whether by lecture, recitation or practice, separately or combined. The address of the secretary is, A. J. Wiechardt, South Bethlehem, Pa.

— The North Carolina Experiment Station has distributed a large quantity of broom-corn seed and instructions as to its cultivation to alliancemen and others, with a view to establishing it among the profitable crops in places well adapted for its best development. Close planting on fairly rich land is required for a good crop of brush fitted for making fine brooms. In order to better assist those who desire to learn all they can of this crop, and that all may have the benefit of as much information as possible on the subject of growing broom-corn and making brooms, the Experiment Station will engage to supply as many as wish a copy of "Broom-Corn and Brooms," a small book published by Orange Judd Co. of New York, at the wholesale price, with the postage added. The usual price is 50 cents. Send 30 cents in silver or stamps to the Experiment Station at Raleigh, if you wish a copy of this little book.

— A paper upon the oxidation of nitrogen by means of electric sparks is contributed, by Dr. V. Lepel, to the current number of the *Annalen der Physik und Chemie.* It is well known that small quantities of nitric and nitrous acids and their ammonium salts are produced during the passage of high-tension electrical discharges through moist air. Dr. V. Lepel's experiments, according to *Nature*, have been conducted with the view of obtaining more precise information concerning the nature of the chemical reactions which occur, and the experimental conditions most favorable for increasing the amount of combination. The first action of the spark discharge appears to be the production of nitric oxide, which is immediately converted by the oxygen present into nitrogen peroxide. The latter then reacts with the aqueous vapor present, forming nitric acid and liberating nitric oxide in accordance with the well-known equation $3NO_2 + H_2O = 2HNO_3 + NO$. It has been found, however, that the continued passage of sparks through the same quantity of moist air does not result, as might at first sight be expected, in the conversion of more and more of the atmospheric gases into oxidized products. For the passage of sparks through the gaseous oxides of nitrogen first formed results in their decomposition again into their elementary constituents. If, for instance, spark discharges are passing at the rate of one per second, the whole of the nitrogen peroxide molecules have not time to react with the water molecules to form nitric acid, before the passage of the next spark, and hence some of them suffer decomposition; indeed, it is probable that a number of the nitric oxide molecules first formed have not even time to combine with oxygen to form the peroxide before the passage of the next discharge, which brings about their dissociation. Hence it is, that, in a closed space, a limit is soon reached beyond which there is no further increase in the amount of nitric acid. For this reason the yield of nitric acid has hitherto been very small. Dr. V. Lepel has made experiments, therefore, with a slowly-moving atmosphere, and under different conditions of pressure, and with various types of spark discharge, with the result that he has already increased the amount of combination to 10 per cent of the total amount of air employed. The air is exposed under increased pressure to a series of parallel spark discharges in the same tube. The change of atmosphere is not made continuously, but intermittently, and the gases are expelled from the discharge tube into a large absorption vessel, in which the products are absorbed in a solution of water, or of a caustic alkali. Detailed accounts are given in the memoir of the efficacy of the various forms of high-tension discharge, and Dr. V. Lepel is now experimenting with the discharge from a Töpler influence machine with sixty-six rotating plates. Of particular interest are his remarks concerning the probable effect of the high-voltage discharges of which we have lately heard so much. He considers it not improbable that by their aid a new mode of producing nitric acid from the atmospheric gases on the large scale may be introduced, rendering us altogether independent of the natural nitrates as a source of nitric acid.

— According to the *Pioneer Mail* of June 8, the residents of Howrah have been finding lately that jackals are animals of anything but an attractive temper. In some cases they have come right up to the bungalows in search of prey. A little girl, aged about five years, was playing in a verandah, when a jackal suddenly rushed on her, and was dragging her away, when she was rescued. She was severely bitten. Three natives, while walking along the Kooroot Road, were attacked by a jackal, which was only driven off after a stubborn fight; and a tale is told of two women, while standing near a tank, being attacked and bitten. So serious has the state of matters become that the public propose to submit a memorial to the district magistrate praying for the adoption of measures for the destruction of these pests.

— C. Creighton, in a letter to *Nature*, June 30, on the immunity of the African negro from yellow fever, says: "This point, interesting to anthropologists, is raised anew by a writer on the history of epidemics (*Nature* June 16), who asks whether the alleged protection is supported by all recent authorities. Recent authorities are not so well placed for judging of this matter as the earlier; for the reason that immunity is not alleged except for the African negro of pure blood or unchanged racial characters, and that these conditions of the problem have been much less frequently satisfied in the yellow fever harbors of the western hemisphere since the African slave trade ceased. However, there was a good opportunity in 1866, during the disastrous yellow fever among the French troops of the Mexican expedition when they lay at Vera Cruz. Among them was a regiment of Nubians, who had been enlisted for the expedition by permission of the Khedive: that regiment had not a single case of yellow fever all through the epidemic. The African negro regiment brought over from the French colonies of Martinique and Guadeloupe had two or three cases, with, I think, one death. The rest of the troops, including Frenchmen, Arabs from Algeria, native Mexicans and Creoles, had no immunity whatever, but, on the other hand, a most disastrous fatality. The medical officers of the French service have recorded the facts principally in the *Archives de Médecine Navale*, their conclusion as to racial immunity being the same that has passed current among the earlier authorities as a truth of high general value (admitting, of course, of exceptions in special circumstances), and a truth that has never, so far as I know, been formally controverted by anyone, although other points concerning yellow fever have been the subject of as obstinate controversy as those touching small-pox itself. The experiences of the French at Gorée, a town with ten times as many negroes as whites, exactly confirmed those of Vera Cruz in the same year (*Arch. de Méd. nav.*, ix., 343). The immunity of the African negro from yellow fever has become a paragraph in some anthropological text-books. It is from the anthropologists, and not from medical authorities, that Darwin cites the fact in his "Descent of Man," adding an original theory of the immunity, which he was unable to establish after much inquiry. His theory, I need hardly say, was not that "negroes in infancy may have passed through some disease too slight to be recognized as yellow fever," — whatever that may mean — "but which seems to confer immunity." The theory, however, is another story, or "another volume," as the writer just cited is pleased to suggest; and as for the historical fact of immunity, no one denies it, unless it be Dr. Pye Smith in his recent Lumleian lectures (*Lancet*, April 23, 1892, p. 901), who gives no reasons. It is unfortunate that the anthropologists (Darwin among them) should have introduced one element of dubiety in placing mulattoes on the same footing, in respect of immunity, as negroes of pure descent, and another in mixing up malarial or climatic fevers with yellow fever."

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LION BREEDING.

BY DR. V. BALL, C.B., F.R.S, HONORARY SECRETARY ROYAL ZOOLOGICAL SOCIETY OF IRELAND.

THE breeding of lion cubs commenced in the gardens of the Royal Zoological Society of Ireland in the year 1857, and has been continued through an unbroken descent to the end of 1891, or for thirty-five years; from which, if we subtract the five years from 1874 to 1878, inclusive — when there was no breeding lioness in the gardens and no cubs were born — the actual period of breeding lasted only thirty years, during which the average number of births has been 5.3 per annum.

Parents of the Cubs.

MALES	No. of Cubs.	FEMALES	No. of Cubs.
		Natalie (1857–9)	10
Natal (1857–64)	42	Anonyma (1861–4)	20
		Old Girl (1862–73)	55
Sire unknown (1869)	3	Nellie (1869)	3
Old Charley (1866–74)	47	Biddy (1871)	4
		Victoria (1879–81)	7
		Zenobia (1879–83)	17
Young Charley ('79–84)	27		
		Queen (1884–91)	28
Paddy (1883–91)	31		
		Minnie (1884-6)	6
Romeo (1890-91)	9	Juliet (1890–91)	9
	159		159

Sexes of the Cubs.

Males	85	Females	73
Unknown	1	Forward	86
			159

Percentage of males to females 53.8 to 46.2, or a majority of 7.6 males out of every 100.

The Number of Cubs in a Litter.

Total number of litters, 43; number of cubs, 159; average number of cubs in each litter, 3.7.

Of litters of	6	cubs there were	2
" "	5	" "	8
" "	4	" "	17
" "	3	" "	9
" "	2	" "	5
" "	1	" "	2

Thus it will be seen that the average number of cubs in a litter approximates most nearly to 4.

Months in which the Cubs were Born.

January	6		July	5	
February	14		August	13	
March	3		September	27	50
April	22	40	October	23	
May	18		November	13	
June	9		December	6	
	72			87	
			Forward	72	
				159	

It is to be remarked that 90 out of the total of 159 were born in the four paired months, namely, April and May (40) and September and October (50). These amount to 56.6 per cent of the whole number, leaving only 43.4 per cent for the remaining eight months.

Disposal of the Cubs.

Died at, or shortly after, birth	30
" after some months or year	12
Retained for stock	8
Sold (yielding upwards of £4,000)	109
	159

THE PURIFICATION OF WATER BY CHEMICAL TREATMENT.[1]

BY WILLIS G. TUCKER, M.D.

PURE water does not exist in nature. It is an ideal substance to which the purest water that can be prepared by the chemist only approximates. From a chemical standpoint every foreign substance which water may contain is an impurity, but, hygienically considered, water is called impure only when it contains excessive amounts of mineral matter in solution or in suspension; when it contains organic matter of vegetable or animal origin, or the products of the decomposition of such matter in quantities exceeding certain generally accepted but rather arbitrarily assigned limits, or when it is shown to contain living organisms believed to be associated with or productive of diseases which water may communicate. All filth in food or drink is to be abhorred, but, none the less, distinction must be made between that which, containing or accompanying specific disease germs, may give rise to specific diseases, and that which is, while not unobjectionable, yet apparently incapable of materially affecting health. The chemist is as yet unable to distinguise disease-producing from relatively harmless impurities in water. He can recognize those constituents which indicate organic pollution; demonstrate the present existence of putrescent material, or show that such material has previously existed

[1] Read before the Medical Society of the County of Albany at a meeting held February 23, 1892. Reprinted from the Albany Medical Annals, April, 1892.

by the recognition of the products of its decay, but he can by no means assert with certainty that any given water will necessarily give rise to disease or will certainly prove to be wholesome. Waters containing putrescent organic matter of animal origin have been drunk without harmful results. Such cases are on record, and, on the other hand, waters which analysis has shown to be of fair chemical purity have unquestionably given rise to disease. Nevertheless the chemical analysis of drinking waters, despite the limitations and imperfections of our best processes, furnishes most valuable information, in no other way to be obtained, and I shall spend no time in a defense of this method of investigation. There are unmistakable signs of pollution which analysis may reveal, and such warnings should not go unheeded. If it be shown that a well receives the leachings of a privy-vault or cesspool, or that a running stream is contaminated by sewage, as yet unoxidized and possibly infectious, such water should be condemned, and neither chemist nor bacteriologist should be required to demonstrate its disease-producing power. Indeed this would be in most cases entirely impossible, such proof being seldom attainable.

Impurities in water exist in suspension or solution, and may be either inorganic or organic. Suspended matter may frequently be removed, wholly or partially, by mere sedimentation or by some simple process of filtration, but matter which is held in solution must be destroyed or removed in other ways. The boiling of water may produce a deposition of some of its earthy salts, a coagulation and precipitation of some of its organic matter, and a destruction of its micro-organisms including disease germs if present; and while this method of purification is frequently serviceable as a household measure it is not adapted to use upon a large scale. By distillation a still further purification may be effected, but this is a still more costly process and can never come into general use. Within a few days I have examined a sample of distilled water prepared and sold in bottles for table use, in which, while the free ammonia was high, the albuminoid ammonia was very low; chlorine, nitrites, and nitrates absent, and total solids almost nil. Such water is as pure as can well be made on a commercial scale, but it is necessarily too expensive to be commonly used. Aeration has likewise been resorted to for the destruction by oxidation of organic matter, and is said to have been employed more than a century ago by Lind on the west coast of Africa. Considerable improvement has been effected in certain city supplies by pumping air into the mains or reservoirs or by discharging water in jets or fountains into basins so as freely to expose it to the air. Where waters are shown to be deficient in dissolved oxygen, especially in the case of impounded waters in which patches of green algæ appear upon the surface in warm weather, such treatment is often of the greatest value. It is an imitation of a natural process of purification, and the change effected is not to be regarded as purely chemical, being brought about by bacterial organisms, the nitrifying bacteria, which, under favorable conditions and in presence of free oxygen, convert nitrogenous organic matter into harmless inorganic forms.

The purification of polluted water by direct chemical treatment has been effected with more or less success in many ways, all practical methods involving the separation of precipitated matter either by sedimentation or filtration after treatment of the water. In other words, there is no chemical agent which, by simple addition to impure water, will render such water pure and wholesome. By chemical treatment we may precipitate lime and other earthy salts if present in undue quantity, coagulate and remove organic matter and bacteria, or promote the oxidation of such matter; and various processes accomplishing, more or less perfectly, these results, have, during recent years, been employed.

Clark's process, designed particularly for the softening of water owing its hardness to bi-carbonate of lime, consists in the addition of milk of lime, which results in the formation of an insoluble carbonate subsequently separated by sedimentation. Colored and turbid waters are clarified and organic matter and living organisms largely reduced by this treatment, as has been shown by Dr. Percy F. Frankland (*Chemical News*, Vol. LII., p. 40) and others, but if much organic matter is present the precipitation does not readily occur and filtration must be resorted to as in the Porter-Clark process. Other methods for softening water involve the use of caustic soda in addition to slaked lime, as in Howatson's process, and the use of tri-sodic phosphate, now a commercial article, by which means the salts producing permanent hardness are largely removed; and in the household carbonate of soda (washing soda) is employed for the same purpose, though its use is impracticable on a large scale on account of the expense.

Such methods as these, however, are primarily intended for purifying water for laundry use, manufacturing purposes, and making steam. They are more important from a technical than from a sanitary standpoint, and we pass from these to speak of those processes in which the main object is the removal of constituents believed to be harmful to health. Before doing so, however, a few words concerning filtration may not be out of place, the more especially as either sedimentation or filtration is generally necessarily connected with every process intended for the purification of water. Filtration which is a mere straining, as for example, continuous filtration through sand or animal charcoal, may clarify a water without otherwise improving it in any respect, and if, after a time, the filter becomes foul, the water may be polluted rather than improved. I regard with disfavor most of the old-fashioned filtering appliances, which not only gave a false sense of security, but often served as breeding places for the growth of living organisms. A house filter which is not easily cleansed is an abomination, being generally allowed to take care of itself and in time becoming a source of real danger. A few years ago a case of no little interest was reported in the *Chemical News* (Vol. LII., p. 70). Two samples of water were analyzed for a family in which one member was ill with typhoid fever. One of the samples was from the house supply direct, and the other was the same water filtered through a portable charcoal filter of the common type. This latter sample yielded a much larger amount of albuminoid ammonia than the former, decolorized five times as much permanganate of potassium, and was in every respect objectionable. On inquiry it was learned that the filter had been in use for more than a year, and that in the place where the owner had formerly resided he had found the water so bad that he had made use of it to filter that which he used for his bath. A few years ago when typhoid fever prevailed in Providence, R.I., and seemed not to be fairly attributable to the city water-supply, Dr. T. M. Prudden examined several of the filters used in private houses and found the typhoid bacillus in no less than three of them (*New York Medical Journal*, Vol. L., p. 14). Filters giving such results, it need scarcely be said, are a constant menace to health, but those which allow of easy cleaning by reversed currents of water are free from most of the objections attending the use of the older forms. Five years

ago I analyzed some samples of Albany water, filtered through a well-known filter manufactured in this city (the Blessing Duplex Filter), and found that a sample of water obtained by washing the filter after a day's use, yielded of albuminoid ammonia, 0.1850 parts per 100,000, showing that the filter had retained a large amount of organic matter. Water which had passed through the sand of the filter only, yielded 0.0023, and that which had passed through both the sand and charcoal yielded but 0.0014 parts per 100,000. This latter quantity is about one-tenth that ordinarily found in our city water, and this is certainly a very good showing. Two years since I analyzed water which had been drawn from our upper service, both before and after filtration through the same filtering apparatus, and found the free ammonia reduced to a fifth, the albuminoid ammonia to a fourth, and the oxygen absorbed to two-thirds of the amounts originally present, by filtration; while a sample of water from the lower city service had its free ammonia reduced to a fifth, albuminoid to a tenth, and oxygen absorbed to a twelfth, indicating a vast improvement in a water at that time in singularly bad condition. These results I believe to be largely due to the efficient action of the animal charcoal, which in this device acts, not as a strainer or filtering medium proper, but as an oxidizing agent, provision being made for its constant aeration. In many filtering appliances animal charcoal is a fruitful source of trouble and danger, but if the real filtration is accomplished by other material and the coal is subjected to frequent aeration and renewed when necessary, it is a most valuable agent for effecting the oxidation of organic matter. I purpose soon to make some experiments with a view to determining how long animal charcoal retains its activity in such filters, though it is very certain that, with proper treatment, it will continue to operate satisfactorily for a long time.

Of the chemical agents which have been employed in water purification, the most important are metallic iron, solutions of iron salts, generally the chloride, permanganate of potassium, and alum. Spongy iron, obtained by the reduction of hematite-ore at a temperature of a little below that of fusion, thereby rendering the metal porous or spongy in form, was first made use of by Bischof, whose process was patented in England in 1871, though Dr. Medlock had secured a patent in 1857 for a process of purification based upon the use of metallic iron plates, and Spencer in 1867 introduced a material which he called magnetic carbide, in which the active agent was iron. The carbonic acid in the water, acting upon the iron in one or the other of these forms, produces a ferrous carbonate, which, by oxidation, yields hydrated ferric oxide, and this is believed to effect the oxidation of organic matter and serve as a coagulant as well, producing a flocculent precipitate, which is subsequently separated by sedimentation or filtration through sand. Such methods have been employed with more or less success in various European cities, but Anderson's process, which has been successfully used at Antwerp, Ostend, Paris, and Vienna, has generally replaced other methods of purification by iron. In this process the water is forced through revolving purifiers consisting of iron cylinders revolving on hollow trunnions which serve for inlet and outlet pipes. On the inner surface of the cylinders are curved ledges running lengthwise, which scoop up and shower down through the water fine cast-iron borings as it flows through the cylinder, so that every portion of the water is brought into contact with the iron, which is kept constantly bright and clean by attrition. The water issuing from the purifiers is exposed to the air, by allowing it to flow through a trough, to secure the precipitation of the ferric hydrate, and by filtration through sand this precipitate is subsequently removed. It is claimed for this process that the organic matter is altered in form and largely destroyed, the albuminoid ammonia being reduced to from one-half to one-fourth, and micro-organisms largely destroyed or removed. At Antwerp 2,000,000 gallons daily are thus treated, and Professor Edward Frankland has shown that this water is completely sterilized and nearly all its organic matter removed. The cost, previous to the introduction of settling reservoirs before filtration, has been $4 per million gallons. In a paper read before the Franklin Institute in 1890 by Easton Devonshire, C.E., it is estimated that the cost of working expenses, with an output of 5,000,000 gallons per diem or over, should not exceed $2 per million.

Ferric chloride has been employed in Holland for removing clayey matter and organic impurities from the water of the Maas, which supplies Rotterdam. Carbonate of iron is formed and decomposed with separation of ferric hydrate which coagulates and removes the organic matter, but such treatment is attended with many difficulties and is not likely to come into general use. The same may be said of the employment of permanganate of potassium, which oxidizes organic matter and by its decomposition yields manganic hydrate which precipitates much of the suspended matter present in the water. Such processes may be successful, here and there, on a small scale, but they cannot as yet be practically or economically employed in the purification of large supplies.

The only other purifying agent of which we need speak is alum. It is said to have been used for centuries in China and India, but particular attention was first directed to its use by Jennet in 1865. Most waters contain more or less bicarbonate of lime in solution, and the alum acting upon this constituent yields sulphate of lime, carbonic acid gas, and aluminic hydrate, as shown in the following equation:

$$K_2Al_2\,(SO_4)_4 + 3\,H_2\,Ca\,(CO_3)_2 = 3\,Ca\,SO_4 + K_2\,SO_4 + 6\,CO_2 + Al_2\,(HO)_6.$$

As the aluminic hydrate forms and deposits it not only entangles and carries down finely-divided, suspended, mineral matter but coagulates and removes much of the dissolved organic matter as well. By this means peaty and other colored waters are decolorized; turbid waters containing finely divided clay are clarified and bacteria removed. Professor A. R. Leeds, in an experiment performed upon the water used at Mt. Holly, N. J., found that alum, added in the proportion of half a grain to the gallon, produced the following effect: "On standing the peaty matter was entirely precipitated in reddish-yellow flakes and the water above became perfectly colorless and clear. On pipetting off some of this supernatant fluid I found that instead of containing 8,100 colonies of bacteria per cubic centimeter, as it did before precipitation with alum, it contained only 80 colonies. On filtering some of this supernatant water through a double thickness of sterilized filter paper into a sterilized tube I found no bacteria in the filtered water. In other words the water had been rendered, by the addition of an amount of alum so minute as to be inappreciable to taste and almost to chemical tests, as sterile as if it had been subjected to prolonged boiling." (*Journal American Chemical Society*, ix., p. 154.)

Austen and Wilber made a valuable report to the State Geologist of New Jersey in 1885, on the "Purification of Drinking Water by Alum." They found that 1.2 grains per

gallon was sufficient for the complete precipitation and clarification of the New Brunswick city water, if sufficient time was allowed for settling. Such an amount is imperceptible to the taste and can exert no physiological action. If more alum is used less time is required for sedimentation, and *vice versa*. More than two grains to the gallon was seldom required. They showed likewise that waters which will not yield clear filtrates on account of their containing finely divided clayey matters, even when filtered through the finest filter-paper, were immediately coagulated and precipitated by 1.16 grains of alum to the gallon, so that they could be filtered immediately after adding the alum, yielding brilliantly clear filtrates, and, in their opinion, no more than twice this quantity, or about two grains per gallon at most, need ever be employed.

In January, 1889, a sample of peaty water from Athol, Mass., having a decided yellowish-brown color, was submitted to me for examination. Difficulty had been experienced in clarifying this water by filtration, and I made some experiments to determine the action of alum upon it. Our city supply was at that time yellowish in color and slightly turbid, and this was also tested. It was found that, in both cases, the addition of alum in the proportion of 2.3 grains per gallon gave rise at the end of twenty-four hours to a yellowish flocculent deposit, undergoing no further change on standing for four days, the water becoming clear and almost perfectly colorless. The waters were tested again by adding the alum, shaking in a flask, and immediately filtering through paper. The city water became transparent and perfectly colorless, and the peaty water retained but a very faint, almost imperceptible yellowish tint. The peaty water yielded originally 0.0225 parts of albuminoid ammonia per 100,000, but after the addition of alum, agitation and filtration, it yielded but 0.0060 parts, or about one-fourth as much, showing how great an improvement had been effected.

For household use, on a small scale, water can be easily clarified and purified by placing a layer of clean cotton, two or three inches deep, at the bottom of a glass percolator, such as is used by druggists, and pouring the water to be filtered, to which solution of alum has been added, into the percolator and allowing it to drip through into a clean vessel placed to receive it. The alum solution is conveniently made by dissolving half an ounce of alum in a quart of water, and of this solution a scant teaspoonful should be added to each gallon of water to be filtered. Alum is now used in a number of filtering and purifying systems which have of late years been brought prominently before the public by their inventors or the companies controlling them.

If now it be asked, do such processes as these which we have described, admit of practical and economical application to the purification of large volumes of polluted water for the supply of our great cities, I fear that an unqualified affirmative answer can hardly be given. In American cities the consumption of water is much greater than in European towns. The "Encyclopedia Brittanica" states that "the consumption varies greatly in different [English] towns, ranging from about twelve to fifty gallons per head per day," and that "an ample supply for domestic use and general requirements is from 20 to 25 gallons per head daily." With us a hundred gallons is frequently supplied. Albany wants 15,000,000 gallons, with a population of less than 100,000. Philadelphia and St. Louis consume 70 gallons; New York, 80; Boston, 90; Chicago, 115; and Detroit, 150; while Glasgow, Dublin, and Edinburgh consume but 50; London, 40; Birmingham, Leeds, and Liverpool about 30; and Manchester and Sheffield still less. On the continent it is about the same. Paris uses about 50 gallons; Hamburg and Dresden 60, and Leipsic but 23. In American cities the waste of water is enormous and to purify one gallon for drinking and household uses and nine gallons for flushing water-closets, watering streets and extinguishing fires must ever be a wasteful process, to say the least. Many towns in this country are now using water purified by artificial means, with apparent satisfaction; but I do not think that the time has come when it can be said that such purification is practicable in all cases. Certain methods, like the Anderson process, give excellent results under favorable conditions, but competent engineers have not recommended them for American cities. Sedimentation, coagulation, filtration, aeration, all these have passed the experimental stage and are in a sense practical, but that processes involving so much manipulation can be advantageously employed in treating the enormous volumes of water required by large cities, especially where pumping is also necessary, is not as yet demonstrated. As regards filtration alone, it may be said that in our climate the filter-beds, which give satisfactory results in many parts of Europe, cannot generally be employed to advantage, and that this method of filtration has been by no means uniformly successful even in Europe. In a recent report Dr. Theobald Smith has called attention to the fact that in the Berlin epidemic of typhoid in 1889, "the distribution of the disease was identical with that of the filtered river water," the filter beds being worked with great rapidity to make up for a deficiency in the water-supply, and the filtered water containing at times 4,000 bacteria per cubic centimeter. In discussing this case he says: "These facts go far to prove that polluted water, when immediately delivered for consumption even after filtration, is not wholly safe. They likewise make prominent the fact, that, while filtration largely rids a given water of its bacteria, it is a process requiring the utmost care, the most constant attention, not only on the part of the engineer, but also of the chemist and bacteriologist. We are furthermore convinced," he adds, "by these experiments that surface water which shows very little, if any, pollution, and which is stored before use, is safer than filtered water which before filtration is being manifestly contaminated with sewage." As regards methods of rapid filtration under pressure, combining chemical treatment of the water, generally by alum, as well, various systems are in use in this country, controlled by individuals or companies employing a variety of patented devices. Granting that the results in some cases seem to be excellent, I think the time has not yet come when they can be unhesitatingly recommended for the purification, in all cases, of large city supplies. I know of no city with a population of one hundred thousand that is using such a process to-day. That numerous infectious diseases are conveyed by water admits of no dispute. In my opinion it is vastly better to purify our sewage before discharging it into the streams which supply us with water, or keep it out of them if practicable altogether, than to attempt to purify the water which it pollutes. Chemical treatment and filtration may be practicable and efficient in certain cases, but I believe that the statement by the Rivers Pollution Commission of England, more than twenty years ago, in their sixth report, is as true now as it was then: "Nothing short of the abandonment of the inexpressibly nasty habit of mixing human excrement with our drinking water can confer upon us immunity from the propagation of epidemics through the medium of potable water." The cities of this country may eventually be driven to methods of arti-

ficial purification of their water supplies, but it cannot be said that the conditions necessitating such action generally exist as yet. In most cases the safer and more economical course will be found to be either the securing of an unpolluted water, if such be available, or the protection from pollution of existing sources of supply.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

American Weeds.

PROFESSOR BYRON D. HALSTED of the New Jersey Experiment Station has recently presented to the agricultural public a list of "American Weeds,"— mostly phanerogams, — which contains no less than 751 varieties and species, exclusive of noxious fungi. Well may the long-suffering farmer turn up the whites of his eyes at this formidable list. A closer examination, however, shows us among the "weeds" all our cultivated clovers, medics, vetches, and many of our best agricultural grasses. The criterion used by the New Jersey botanist in deciding what to admit and what to exclude from his catalogue is not apparent, and no word of explanation is vouchsafed.

In the vegetable kingdom, if not in the United States Republic, it is true that "it is self-evident that all plants are born free and equal." The distinguishing of plants as weeds and not weeds is purely human and artificial. The popular idea of a weed seems to be a repulsive, or hurtful, wild plant. But few persons give exactly the same definition. I have been at some trouble to secure the definitions of a number of intelligent persons, and give below a few samples: —

"A plant where you don't want it." — *Director Experiment Station.*

"A noxious or useless plant." — *Curator of Museum.*

"A plant out of place." — *Chemist.*

"A troublesome plant." — *Chemist.*

"An obnoxious plant of many species not fit for food or medicinal purposes." — *Clerk.*

"A plant not edible, so far as known, nor medicinal, or otherwise serviceable to man, and which always thrives where not wanted."—*Inspector of Fertilizers.*

"A plant for which we have no use so far as we know."— *Meteorologist.*

"(1) Underbrush or bushes; (2) a useless or troublesome plant." —*Webster.*

My own definition: Any plant which from its situation or inherent properties is hurtful to human interests; a vegetable malefactor.

By the usage of the English language the name "weed" is connotative and implies in a plant a bad and hurtful quality. Used metaphorically or analogically it is always a term of opprobrium.

If we were dealing with individual plants as courts of justice deal with persons, each particular plant might he properly described as a weed or not weed according to the circumstances of each case. But here we are dealing not with individuals but with species and varieties, and can take note only of the general character of the groups. If we have planted a bed of pansies, and there springs up among the pansies a red clover plant, this particular plant is hurtful to us, and therefore is treated as a weed, but we are not therefore justified in writing the species *Trifolium protense* in a list of weeds. The general character, — the qualities for which the clover genus generally and this species especially are noted, are good and beneficial to mankind. It was only by chance or the carelessness of some one that this clover plant got into our flower-bed. "The plant out of place" definition of a weed can refer only to a particular plant. It cannot be applied to a species, for a plant of any species is liable to be occasionally misplaced.

We must maintain then that the inclusion in a list of weeds of such plants as the clovers, medics, vetches, and agricultural grasses is unjustifiable and wrong.

A large number of Professor Halsted's "weeds" are mere "wildlings of nature" for which we have as yet found no important use. But justice requires that in the case of plants as well as persons every one shall be held innocent until proven guilty of wrong.

Both from an æsthetic and from a practical standpoint it is true that most of these so-called weed plants are more useful than hurtful. They clothe and beautify waste places. Many of these wild plants furnish food and nectar for honey bees, and all aid more or less in conserving the fertility of the soil, prevent washing etc. It is as unjust to stigmatize such plants as "weeds" as it would be to call all savage tribes criminals.

Professor Halsted omits wholly and without comment noxious fungi from his list of weeds. Yet these are our very worst and most dangerous weeds. In number they far outrun all the phanerogamic species.

To justify its inclusion in a list of "American weeds" a plant must not only possess a positively noxious character, but must also be sufficiently obnoxious or wide spread to give it a national reputation.

If we exclude from Professor Halsted's list all obscure and non-noxious species we shall have left about 150 *species* of weed-plants worthy to be called "American Weeds."

GERALD MCCARTHY.

N. C. Experiment Station, July 5.

Some Remarks on Professor Cyrus Thomas's Brief Study of the Palenque Tablet.

IN *Science*, No. 488, Professor Cyrus Thomas stated that "the particular manner of reckoning the days of the month"— or more precisely, the exact designation of a date by the sign of the day and the position it holds in the number of twenty days (*uinal*) that people are in the habit of calling a Maya month — as it is found not only "in some of the series of the Dresden Codex," but throughout the whole of it, is also found on the Palenque tablet. This statement undoubtedly is a correct one. But Professor Thomas, following Professor Förstemann, asserts that the "peculiarity of this method is that the day of the month is counted not from the first of the given month, but from the last of the preceding month; thus the fifteenth day of *Pop*, beginning the count with the first, will, according to this method, be numbered 16." If it were really so, this method of reckoning the days of the month would be a very curious one, and hardly to be understood. Professor Förstemann based this assertion on the supposition that the calendar system of the Dresden Codex is the same as that which prevailed in Yucatan at the time of Bishop Landa's writing. In vol. xxiii. of the *Zeitschrift für Ethnologie*, published by the Berlin Anthropological Society, in a paper entitled "Zur mexikanischen Chronologie, mit besonderer Berücksichtigung des zaposekischen Kalenders," I have shown that the priests who wrote down the Dresden Codex did not begin their years with the days *kan, muluc, ix, cauac*, as in Landa's time, but with the days *been, e'tznab, akbal, lamat*, exactly corresponding to the *acatl, tecpatl, call, tocbtl* (cane, flint, house, rabbit), the signs used by the Mexicans to designate their respective years. Beginning the years in this manner, the day 4 *ahau* 8 *cumku* is really the eighth day of the month *cumku* in the *been*, or "cane," years. The day 9 *kan* 12 *kayab* is really the twelfth day of the month *kayab* in the same *been*, or "cane," years; and thus with all the other dates throughout the whole Dresden Codex.

The evidence derived from the fact that the same method of numbering the days of the month, that is to say, the same method of beginning the years, is also found in the Palenque tablet, leads — I agree with Professor Thomas — to the inference "that there were intimate relations between the people of this city and those where the Dresden Codex was written, and that there is no very great difference in the ages of the two documents." On the other

side, it is proved by my statements that in this peculiarity both the Dresden Codex and the Palenque tablet differ from the Codex Troano-Cortez. For in the latter document the beginning of the years is in the days *kan*, *muluc*, *ix*, *cauac*. This is proved by Codex Troano 23–20, when compared with the Dresden Codex 25–28. From this, and the general character of the Codex Troano-Cortez, we may safely infer that this manuscript is of a later date than the Dresden Codex, and, perhaps, of a somewhat different locality.

Alluding to 9 C 9 D of the Palenque tablet, Professor Thomas remarks that on plate 48 and twice on plate 50 of the Dresden Codex no number-symbol is attached where the day is the twentieth of the month. This is obviously an erroneous statement; for in all the three cases named, and also in the Palenque tablet, there is a particular element attached to the hieroglyph of the month; and this particular element reveals itself as a graphic representation of the two eyes of the man (*uinic*), the substitute of the head of the slain, which I have shown is the usual representation of the man (*uinic*) or the number twenty (*uinal*) (see *Zeitschrift für Ethnologie*, XIX., pp. 237–240.

With reference to Professor Thomas's last remarks, I will add that the symbol of the hand, as it is seen in the hieroglypth *mänik*, is to be understood as a sign-language character for "to eat," and therefore has the phonetic value *chi* (compare the hieroglyph *chikin*, west). The figure of the outstretched hand occurs as a substitute for the hatchet, the probable expression of the sound *ch'ac*, "to cut." The proper phonetic and figurative value of the outstretched hand seems to be *pax*, "to beat."

DR. ED. SELER.

Steglitz, Germany, June, 1892.

A Grape Vine Produces Two Sets of Leaves During the Same Season.

THE scarcity of information upon the production of leaves at abnormal times furnishes an excuse for the following communication.

In the yard adjoining me there is a large grape-vine of several years' growth. A month ago this was a vigorous plant; the leaves were numerous and healthy, and the branches were loaded with grapes. About that time numerous caterpillars attacked the vine, and in less than a week there was not a leaf left upon it. Numerous petioles, bearing fragments of the principal veins, were all that remained of the foliage. The grapes began to shrivel, and the smaller twigs to show signs of premature decay.

But the end was not yet. About a week after the leaves were destroyed, buds located at the nodes — buds which normally would have remained dormant until next year — began to develop a second foliage. Although not yet full-grown, these leaves have given a new lease of life to the vine. The few shriveled bunches of grapes that have survived the great draught upon their moisture are rapidly regaining their plumpness. The plant is itself again.

One fact is worth noting; although almost four weeks have elapsed since the leaves were destroyed, the petioles remain attached to the stems. These petioles are as green as ever, and in most cases they retain short bits of the principal veins of the leaves. Near the petioles these veins are green, but their free extremities are shriveled and brown.

C. H. TURNER.

University of Cincinnati, July 10.

BOOK-REVIEWS.

The Stone, Bronze, and Iron Ages. A Popular Treatise on Early Archæology. By JOHN HUNTER-DUVAR. London, Swan Sonnenschein & Co. New York, Macmillan & Co. 285 p. $1.25.

AS the author claims for this book no other character than that of a popular treatise, it will be sufficient to inquire whether it is a fair representation of the most approved views of the science, as expressed by those who have made it a speciality. This it usually is, although the author, who never quotes his authorities, has inserted opinions here and there which are certainly not those generally accepted. For instance, he understates the artistic relics of the Palæolithic period; he assumes that the weapons of the river drift were more ponderous than those of later date; he asserts that no idols have been recovered from the stations of that epoch; and that no human remains have been unearthed from the European kitchen-middens. Our countrymen will also be surprised to learn that Mound City is another name for St. Louis (p. 142).

In spite of such slight blemishes, the book can be recommended as a convenient and usually accurate manual of this attractive science. It begins at the beginning, tracing the story of man from early post-tertiary times through the drift and cave periods in Europe, and the neolithic, bronze, and iron ages. There are special chapters on the lake-dwellers, fossil man, myths, pottery, sepulture, and art, and one on the mound-builders of the Ohio Valley.

Journal and Proceedings of the Royal Society of New South Wales. Vol. XXV. 1891. 348 p.

THE creditable publications of this active society have already reached their twenty-fifth volume, and it comes replete with entertaining material. Several reports from the Sydney Observatory on celestial photography will have interest for the astronomer; articles on Kaolinite and the microscopic structure of Australian rocks will attract the geologist; the causes of death among sheep and rabbits in Australia will be welcome to the agriculturist; the folk-lorist will turn with pleasure to Mr. Pratt's translations of songs and myths from Samoa; while the mechanicians and cranks will be glad to read about a ship which can be propelled by the action of the waves alone, and a flying machine which is to navigate the sky by the motive power of compressed air. This is certainly a varied repast, at which each may find a dish to his liking.

AMONG THE PUBLISHERS.

A WORK on the "Migration of Birds," by Charles Dixon, will shortly be published by Messrs. Chapman & Hall.

— Messrs. Longmans, Green, & Co. have issued a third edition, revised and enlarged, of Professor E. A. Schäfer's "Essentials of Histology." The intention of the author is to supply students with directions for the microscopical examination of the tissues.

— A "Dictionnaire de Chimie industrielle" is being issued in parts, under the direction of A. M. Villon, by the "Librairie Tignol." It gives an account of the applications of chemistry to metallurgy, agriculture, pharmacy, pyrotechnics, and the various arts and handicrafts.

— Henry Stevens & Son, 39 Great Russell Street, London, promise for next month Henry Harisse's "Discovery of North America: a critical, documentary, and historic investigation, with an essay on the early cartography of the New World," etc. This important work by the foremost investigator in the field will make a quarto volume of 800 pages, with 23 plates and many illustrations in the text, and will be issued to subscribers in three styles, ranging in price from £5 to £12 16s. Only 360 copies are to be printed.

— The American Society for the Extension of University Teaching, Philadelphia, has just issued five monographs on various phases of the university extension movement, being reprints from the Proceedings of the Society. These are: "The Place of University Extension in American Education," by William T. Harris, U. S. Commissioner of Education; "The Organization and Function of Local Centres," by Michael E. Sadler, secretary of the Oxford University Extension Delegacy; "The Church and University Extension," by Rev. John S. Macintosh; "The Ideal Syllabus," by Henry W. Rolfe; and "The University Extension Class," by Edward T. Devine.

— With the number for July, the "Annals" of the American Academy of Political and Social Science begins its third volume. The first article in the current number is entitled "Cabinet Government in the United States." It is by Professor Freeman Snow of Harvard, and is an answer to the many pleas for the adoption

in the United States of cabinet government as known abroad. The next article is by Mrs. S. L. Oberholtzer, and relates how much good "School Savings Banks" have done and are doing. Professor J. B. Clark of Smith College has a paper on "Patten's Dynamic Economics," in which he explains the latest system of political economy, taking up Professor S. N. Patten's recent book as a basis for his remarks. Professor Léon Walras of Lausanne contributes an article on the "Geometrical Theory of the Distribution of Prices," in which he presents a geometric picture of the causation of the prices of all commodities Besides these there are articles by Mr. B. F. Hughes on "Basis of Interest," by Leo S. Rowe on the "Conference of the Central Bureau for the Promotion of the Welfare of the Laboring Classes," by Takekuma Okacla on "Taxation in Japan," and the usual book-reviews and personal notes.

— W. H. Lowderwilk & Co., Washington, announce that they have assumed the publication of "Hickcox's Monthly Catalogue of Government Publications," which they will complete up to date and issue regularly and promptly in the future. Mr. Hickcox will edit the catalogue as heretofore, but all rights in the work have been purchased by the publishers. Up to this time the work has been prosecuted under many difficulties, and the pecuniary returns have been very inadequate, by reason of which facts it was not kept up with the regularity which its importance demanded. It is expected to issue early in July the first six numbers of 1892, under one cover, succeeding numbers to follow early in each month thereafter. As rapidly as the matter can be prepared the back volumes will be completed and sent to subscribers. It is not expected that the undertaking will prove a remunerative one, but it is hoped that there will be a return sufficient to repay the actual outlay of money. The work is of the utmost value to every person who has occasion to handle or consult the current publications of the government, and these publications are now so varied and comprehensive that persons interested in any branch of science or business must appreciate it.

— Under the title of "The Cambridge Natural History," Macmillan & Co. have in active preparation an important series of volumes on the Natural History of Vertebrate and Invertebrate Animals, edited, and for the most part written, by Cambridge men. While intended in the first instance for those who have not had any special scientific training, the volumes will, as far as possible, present the most modern results of scientific research. Thus the anatomical structure of each group, its development, palæontology, and geographical distribution, will be considered in conjunction with its external character. Care will, however, be taken to avoid technical language as far as possible, and to exclude abstruse details which would lead to confusion rather than to instruction. The series will be under the general editorship of Mr. J. W. Clark, the university registrar, and Mr. S F. Harmer, superintendent of the Museum of Zoölogy. The following writers

Publications Received at Editor's Office.

BUSH, GEORGE G. History of Higher Education in Massachusetts. Washington, Bureau of Education. 8°, paper. 455 p.

HUNTER-DUVAR, JOHN. The Stone, Bronze and Iron Ages. New York, Macmillan & Co. 12°. 285 p. $1.25.

MAYO, A. D. Southern Women in the Recent Educational Movement in the South. Washington, Bureau of Education. 8°, paper. 330 p.

MERZ, CHARLES H. Influenza. Sandusky, O. Beecher & Co., Printers. 12°, paper. 96 p.

U. S. DEPARTMENT OF AGRICULTURE. Foods and Food Adulterants. Part 7: Tea, Coffee and Cocoa Preparations. Washington, Government. 8°, paper.

——Experiments with Sugar Beets in 1891. Washington, Government. 8°, paper.

——Record of Experiments with Sorghum in 1891. Washington, Government. 8°, paper.

WEISMANN, AUGUST. Essays upon Heredity. Trans. by E. B. Poulton and A. E. Shipley. Vol. II. Oxford, Clarendon Press. 12°. 236 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion. [illegible] "America[illegible] [illegible] subject. W[illegible] ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g to 1-10mg), platinum dishes and crucibles, agate motors, [illegible] apparatus, etc. For sale in part or whole. A[illegible] file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, [illegible]. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species." by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants

Any [illegible] for which he is qualified by [illegible], or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if [illegible] publisher of the suitable character of [illegible]. Any person seeking information on a[illegible] question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

WANTED.—A collection of postage stamps; one made previous to 1870 preferred. Also old and curious stamps on original letters, and old entire U S. stamped envelopes. Will pay cash or give in exchange first-class fossils, including fine crinoids. WM. F. E. GURLEY, Danville, Ill.

WANTED.—To purchase laboratory outfit; balances, evaporating dishes, burettes, etc., wanted [illegible] cash. C. E. SPEIRS, 23 Murray [illegible]. P. O. Box 1741.

WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred [illegible] of [illegible] some knowledge [illegible], stating age and [illegible] Optical, care of Science, 874 Broadway, New York.

WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review, vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol 1 to 9; Art Union, vol. 1 to 4, Jan., [illegible]; Bibliotheca Sacra, vol 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

WANTED.—By a young man, a Swarthmore College junior, a position as principal of a public high school in one of the Gulf States, or as instructor in [illegible] and geology in an academy or normal school. Address B., care of Librarian, Swarthmore College, Penn.

WANTED.—To act as correspondent for one or two daily or weekly papers. Have worked on paper for about two years Would like a position on editorial staff of humorous paper. Address GEO. C. MASON, 14 Elm St., Hartford, Conn.

TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

are engaged upon the groups which precede their names: Mammals, Mr. J. J. Lister; Birds, Mr. A. H. Evans; Reptiles and Amphibia, Dr. Gadow, F.R.S.; Fish, Mr. W. Bateson; Mollusca, Mr. A. H. Cooke; Polyzoa, Mr. S. F. Harmer; Brachiopoda, Mr. A. E. Shipley; Insects, Mr. David Sharp, F.R.S.; Myriapoda, Mr. F. G. Sinclair; Arachnoida, Mr. C. Warburton; Crustacea, Professor W. F. R. Weldon; Cœlenterata, Mr. S. J. Hickson; and Sponges, Dr. W. J. Sollas. It is hoped that some of the volumes which are already far advanced may appear in the course of next year. The series will be fully illustrated.

— The Biblia Publishing Company of Meriden, Conn., has just issued its initial monthly number of "Ancient Egypt in the Light of Modern Discoveries," edited by Chas. H. S. Davis, Ph.D., and Rev. Camden M. Cobern, Ph.D., with an introduction by Rev. W. C. Winslow, LL.D. Over one hundred illustrations will appear in the twenty-four monthly parts; in the June issue are maps of Egypt as a whole, of Upper Egypt, of Lower Egypt, of the Basin of the Nile, of the Canal of Joseph, and of Egypt during the pluvial period; this opening chapter treats of "Egypt and Its Original Inhabitants," and it is largely ethnographical in its cuts and letterpress.

— Mr. F. Turner contributes to the April number of the *Agricultural Gazette of New South Wales* a paper on the carob bean tree as one of the commercial plants suitable for cultivation in New South Wales. The Agricultural Department distributed a quantity of seed last year, and some healthy young plants raised from this seed are now growing in several parts of the colony. Mr. Turner expects that when the tree becomes better known to cultivators it will be extensively grown to provide food for stock, more especially during adverse seasons. The carob can not only be trained into a very ornamental shade tree, but may be planted as a wind-break to more tender vegetation. He advises all who cultivate it to keep bees, if only a single hive. It is astonishing, he says, how many flowers these industrious insects will visit in the course of a day, and be the agency whereby they are fertilized.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Lay, Notes on the Fertility of.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Baldwin, J. Mark, University of Toronto, Canada.
Barnes, Charles Reid, Madison, Wis.
Baur, G., Clark University, Worcester, Mass.
Beal, W. J., Agricultural College, Mich.
Beals, A. H., Milledgeville, Ga.
Beauchamp, W. M., Baldwinsville, N.Y.
Boas, Franz, Clark University, Worcester, Mass.
Bolley, H. L., Fargo, No. Dak.
Bostwich, Arthur E., Montclair, N.J.
Bradley, Milton, Springfield, Mass.
Brinton, D. G., Philadelphia, Pa.
Call, E. Ellsworth, Des Moines, Ia.
Chandler, H., Buffalo, N.Y.
Comstock, Theo. B., Tucson, Arizona.
Conn, H. W., Middletown, Conn.
Cragin, F. W., Colorado Springs, Col.
Davis, W. M., Harvard College, Cambridge, Mass.
Dimmock, George, Canobie Lake, N.H.
Farrington, E. H., Agricultural Station, Champaign, Ill.
Ferree, Barr, New York City.
Flexner, Simon, Johns Hopkins University, Baltimore, Md.
Foshay, P. Max, Rochester, N.Y.
Gallaudet, E. M., Kendall Green, Washington, D.C.
Garman, S., Museum of Comp. Zool., Cambridge, Mass.
Golden, Katherine E., Agricultural College, Lafayette, Ind.
Hale, Edwin M., Chicago, Ill.
Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
Hall, T. Proctor, Clark University, Worcester, Mass.
Halsted, Byron D., Rutgers College, New Brunswick, N.J.
Haworth, Erasmus, Oskaloosa, Iowa.
Hay, O. P., Irvington, Ind.
Haynes, Henry W., Boston Mass.
Hazen, H. A., Weather Bureau, Washington, D.C.
Hewitt, J. N. B., Bureau of Ethnology, Washington, D.C.
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